Skeletal System - General

**bones, cartilage** and **ligaments** tightly joined to form a strong, flexible framework

bone is **active** tissue:

\[ \pm 5\text{-}7\% \text{ bone mass/week} \]

**Functions of Skeletal System:**

1. **Support**
   strong and relatively light; 20\% body weight

2. **Movement**
   framework on which muscles act

3. **Protection**
   brain, lungs, heart, reproductive system

4. **Mineral storage (electrolyte balance)**
   99\% of body’s calcium is in bone tissue
   also stores phosphate

5. **Hemopoiesis**
   blood cell formation

6. **Detoxification**
   bone tissue removes heavy metals and other foreign materials from blood
   can later release these materials more slowly for excretion
   but this can also have bad consequences

**Skeletal Anatomy**

each individual bone is a separate **organ** of the skeletal system

~270 bones (organs) of the Skeletal System
   with age the number decreases as bones fuse

by adulthood the number is 206 (typical number mentioned)

even this number varies due to varying numbers of minor bones:

   **sesamoid bones** – small rounded bones that form within tendons in response to stress
   eg. kneecap (patella), in knuckles
**wormian bones** – bones that form within the sutures of skull

Each skeletal organ is composed of many kinds of tissues:
- bone (= osseous tissue)
- cartilage
- fibrous connective tissues
- blood (in blood vessels)
- nervous tissue

Bones can be categorized according to their general shape:

1. **long**: cylindrical, longer than wide
   - Rigid levers for muscle actions eg crowbars
   - Eg. arms, legs, fingers, toes

2. **short**: length nearly equal width
   - Limited motion, gliding if any
   - Eg. carpals, tarsals, patella

3. **flat**: thin sheets of bone tissue
   - Enclose and protect organs
   - Broad surfaces for muscle attachments
   - Eg. sternum, ribs, most skull bones, scapula, os coxa

4. **irregular**: elaborate shapes different from above
   - Eg. vertebrae, hip bones, sphenoid, ethmoid

**Bone Structure**

Bones have outer shell of **compact bone**

Usually encloses more loosely organized bone tissue
- = spongy (= cancellous) bone

The general structure of a typical longbone:
**epiphyses**
- large surface area for muscle attachment and pivot
- spongy bone with traebeculae
- red marrow – hemopoiesis

**diaphysis**
- thick compact bone
- support but light
- hollow ≗ medullary cavity

**periosteum**
- white fibrous connective tissue
- penetrates bone – welds
- blood vessels to bone
- continuous with tendons

**articcular cartilage**
- resilient cushion

**medullary cavity**
- yellow marrow – fat (adipose) storage
- fat storage

**endosteum**
- fibrous CT that lines medullary cavity

**Microscopic Structure (Histology)**

A. bone:
- connective tissue
- contains cells and matrix

- matrix predominates
  - ~ 1/3rd organic and 2/3rd’s inorganic

- contains lots of collagen fibers

- bone cells = **osteocytes**

1. **calcified (compact) bone tissue**
   - highly organized arrangement of matrix and cells
   - perforating canals (Volkmann canals)
   - interconnect the haversian canals

2. **cancellous (spongy) bone tissue**
has numerous spaces

**trabeculae** = scaffolding  
arranged along lines of strain

periosteum provides life support system for bone cells

blood vessels penetrate bone and connect with those in haversian canals

**B. Bone Marrow**  
not a tissue but a general term for any soft  
tissue that occupies the medullary cavity or the spaces within  
spongy bone

*Red bone Marrow*  
hemopoietic tissues $\vdash$ produces blood cells  
in delicate mesh of reticular tissues

in adults red marrow is limited to vertebrae,  
sternum, ribs, pectoral and pelvic girdles, proximal heads of  
humerous and femur

with age, red marrow is replaced by yellow marrow

*Yellow Bone Marrow*  
mostly adipose tissue

“fat at the center of a ham bone”

in event of severe anemia, yellow marrow can  
transform back into red marrow to make blood cells

**C. cartilage**

resembles bone:  
large amount of matrix  
lots of collagen fibers

differs:  
firm flexible gel is not calcified (hardened)  
no haversian canal system  
no direct blood supply  
$\vdash$ nutrients and $O_2$ by diffusion
all bone starts out as cartilage

in bone the matrix is hardened (= ossified) by calcification (or mineralization)

microscopic structure of cartilage:
   chondrocytes in lacunae

kinds of cartilage:
   (all similar matrix with lots of collagen fibers; differ in other fibers)

1. hyaline
   most common
   eg. covers articular surfaces of joints, costal cartilage
       of ribs, rings of tracheae, nose

2. fibrous
   mostly collagen fibers
   eg. discs between vertebrae, pubic symphysis

3. elastic
   also has elastic fibers
   eg. external ear, eustacean tube